Space Weather Technical Forecast

Issued on Friday, 14 June 2024 at 00:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor Geomagnetic storm day 2. Chance of isolated M-flares (R1-R2 radio blackouts). Slight chance of Minor solar radiation storm (S1) initially, this risk declining into the period.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Moderate, with an isolated M3.2 at 13/1645 UTC attributed to AR3713 in the southeast. There are currently 9 sunspot regions on the visible disc. The largest and most significant region is AR3712 in the southeast, which has developed through the period and is now classified as a Eki/beta-gamma-delta. AR3713 has also developed, gaining intermediate spots and a Dsi/beta-gamma classification. AR3709 is a slightly smaller mature region, consisting of a single leader followed by smaller trailing spots and has shown little or no development in recent hours. The other regions are relatively small and simple.
No Earth directed CME's were observed during the period.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by ACE at L1, were indicative of a slow regime. The speed was stable and slow-ambient, generally between 320-350 km/s, with below average density. The IMF (Interplanetary Magnetic Field), Bt, was weak and unremarkable throughout, with only slight deviations (-2/+5nT) of the north-south component, Bz. The phi angle was predominantly positive (away from the Sun), until 13/1707 UTC then changed to become negative (towards the Sun). Geomagnetic activity was Quiet (Kp 0-1) as a result.

Energetic Particles / Solar Radiation: The high-energy (greater than 10 MeV) proton flux observed by GOES18 remained below the S1 threshold, declining from 8 pfu to 2 pfu through the period.

High energy electron flux (greater than 2MeV) observed by GOES16 was at background levels, with the associated 24-hour fluence well below Active. Observed fluence at 14/0000 UTC was 1.2e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: There is a chance of further isolated M-class flares, with just a slight chance of X-flares, with any significant flares most likely from AR3712 and also AR3713.

Solar Wind / Geomagnetic Activity: A faint CME associated with a M1 flare at 12/2246 UTC is now expected to have an Earth directed component, possibly reaching Earth later on Day 2 (15 Jun). A weak high speed stream from CH45 may also connect to Earth later day 3 (15th) into day 4 (16th).
Overall geomagnetic activity is expected to start at Quiet (Kp 0-2) levels, then increase to become Active to G1 (Kp 4-5) later tomorrow, with a chance of Moderate/G2 (Kp 6) intervals. Geomagnetic levels then decline to become Quiet to Unsettled (Kp 2-3) for days 3 and 4 (16-17th), but with a chance of isolated Active (Kp 4) intervals.

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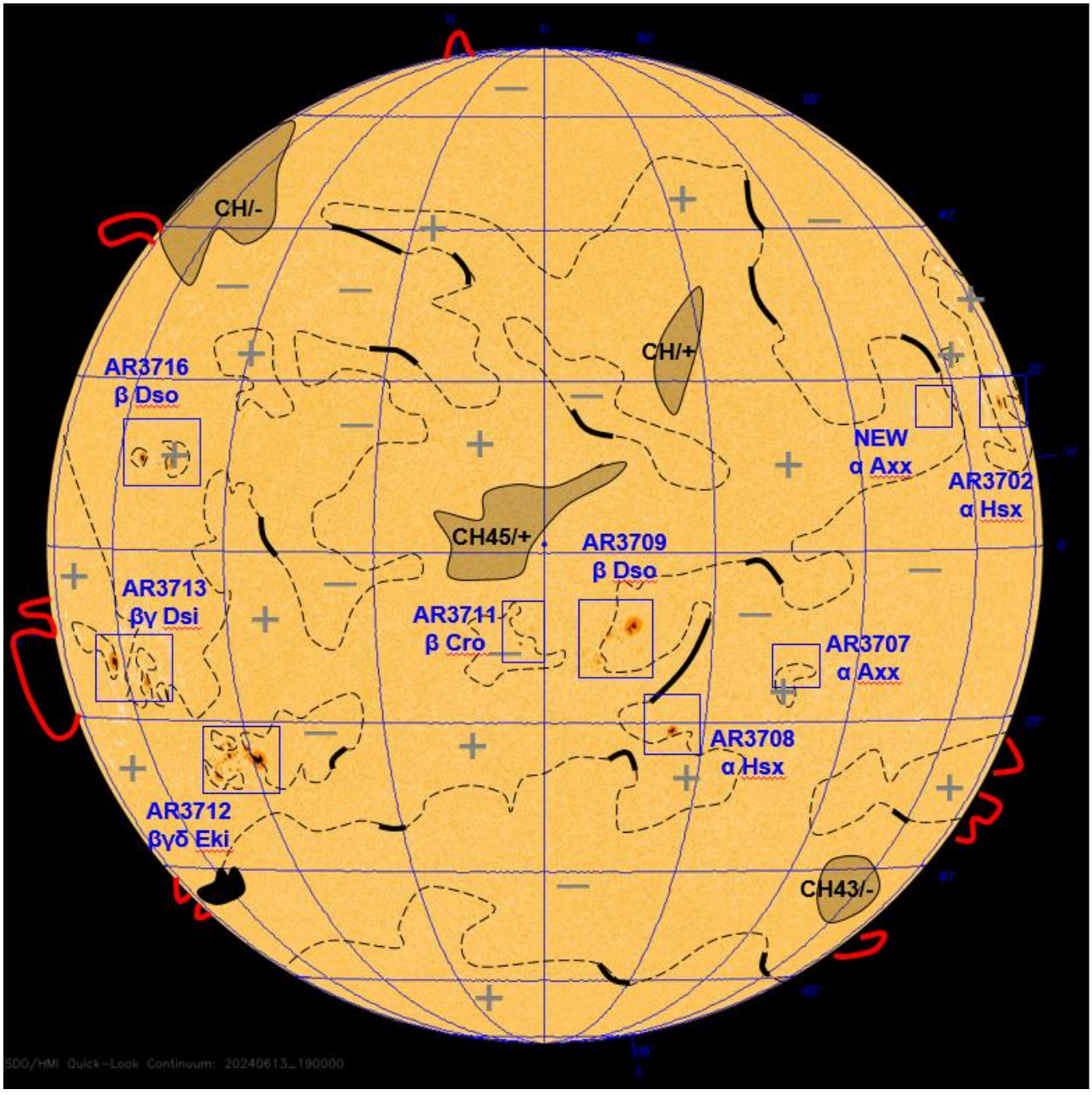
Energetic Particles / Solar Radiation: High energy proton flux is expected to continue to decline over the coming days, remaining below the S1/Minor storm levels. The chance of enhancement continues to decline.
High energy electron flux is forecast to persist at predominantly background levels, and the associated 24-hour fluence is expected to remain below the Active threshold.

Figure 1. Solar Analysis Valid 13/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A faint CME associated with a M1 flare at 12/2246 UTC from AR3711 is now expected to have an Earth directed component, reaching Earth later on Day 2 (15 Jun). Confidence is low regarding the arrival time and impact, due to the weak nature of the CME and gaps in the imagery for analysis. Currently only G1/Minor Geomagnetic storms are likely.
The chance of Earth connecting to a HSS from CH43 appears to have faded. The next coronal hole feature is CH45 almost centre disc. Its high speed stream may connect with Earth on Day 3 (16 June) but it's difficult to estimate the level of geomagnetic response given it was absent on the last rotation. Judging from its size though, it should not be able to bring much more than slightly elevated solar wind speeds and a few Unsettled geomagnetic intervals.

Overall geomagnetic activity is expected to start at Quiet (Kp 0-2) levels, then increase to become Active to G1 (Kp 4-5) later tomorrow, with a chance of Moderate/G2 (Kp 6) intervals. Geomagnetic levels then decline to become Quiet to Unsettled (Kp 2-3) for days 3 and 4 (16-17th), but with a chance of isolated Active (kp 4) intervals due to a potential weak HSS from CH45 arriving.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	50	10	10
Strong	G3	No	1	1	5	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
13/0131	Full	AR3711	SE	850	14/1200	Low confidence but unlikely to have significant impact

Figure 2: MOSWOC Enlil (left) and ensembles (right) indicating a CME arrival on day 2 (15th).

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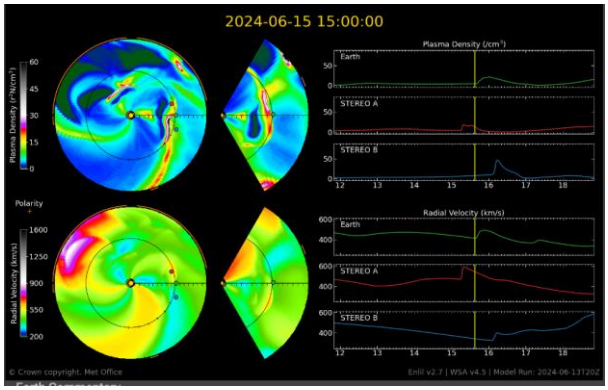
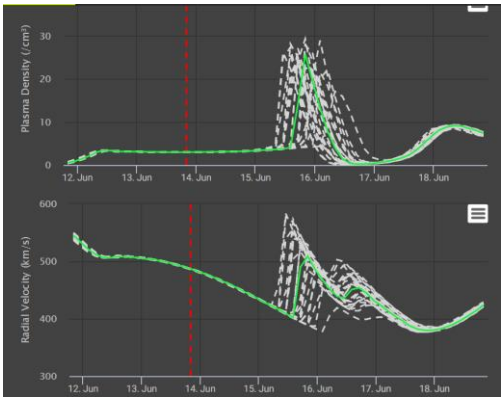




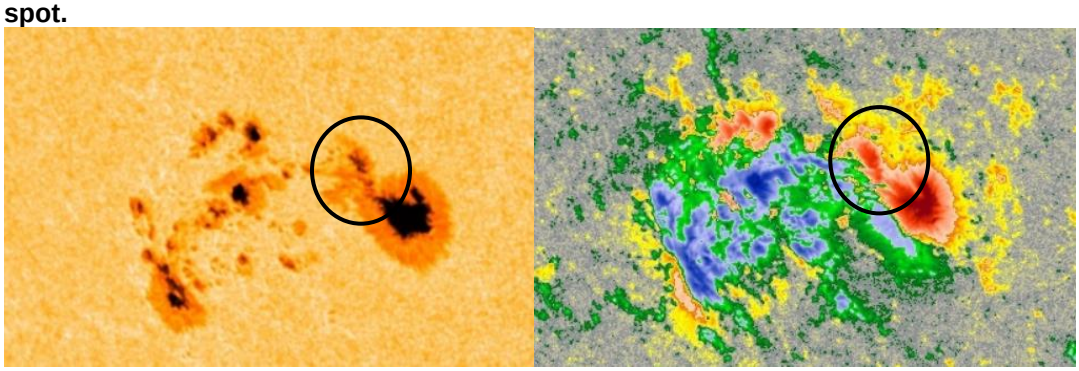
Radio Blackouts - X-Ray Flares:

There are currently 9 sunspot regions on the visible disc, although one is not numbered and AR3707 is barely visible after decreasing. The largest and most significant region remains AR3712 in the southeast, which has continued to develop. AR3712 has gained intermediate spots, but also the consolidation of leading spots into an asymmetric penumbra, resulting in the formation of a small delta spot and a Eki/beta-gamma-delta classification. AR3713 and AR3716 have also recently developed in size, with AR3713 also increasing in magnetic complexity, becoming a beta-gamma configuration due to the growth of intermediate spots.

There is a chance of further M-class flares, with only a slight chance of X-flares, most likely from AR3712 or AR3713.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: Latest SDO images (left intensitygram and right magnetogram) showing AR3712 and delta spot.



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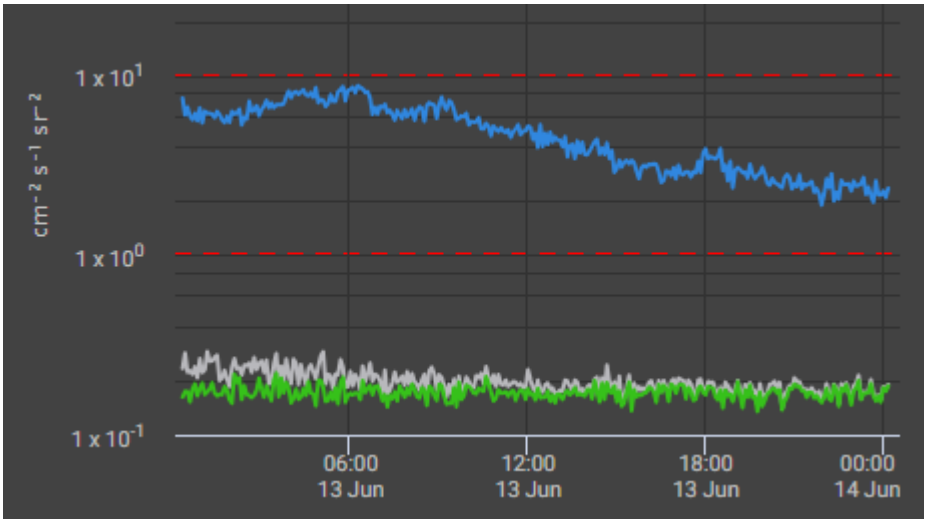
Solar Radiation Storms - (High Energy Protons):

High energy proton flux is expected to continue to decline over the coming days, remaining below the S1/Minor storm levels as previous region AR3697 continues to rotate further across the far side and the most significant regions on the visible disc are currently in the eastern hemisphere.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	5	5	5
Very Active	**≥ S3**	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES18 Proton Flux



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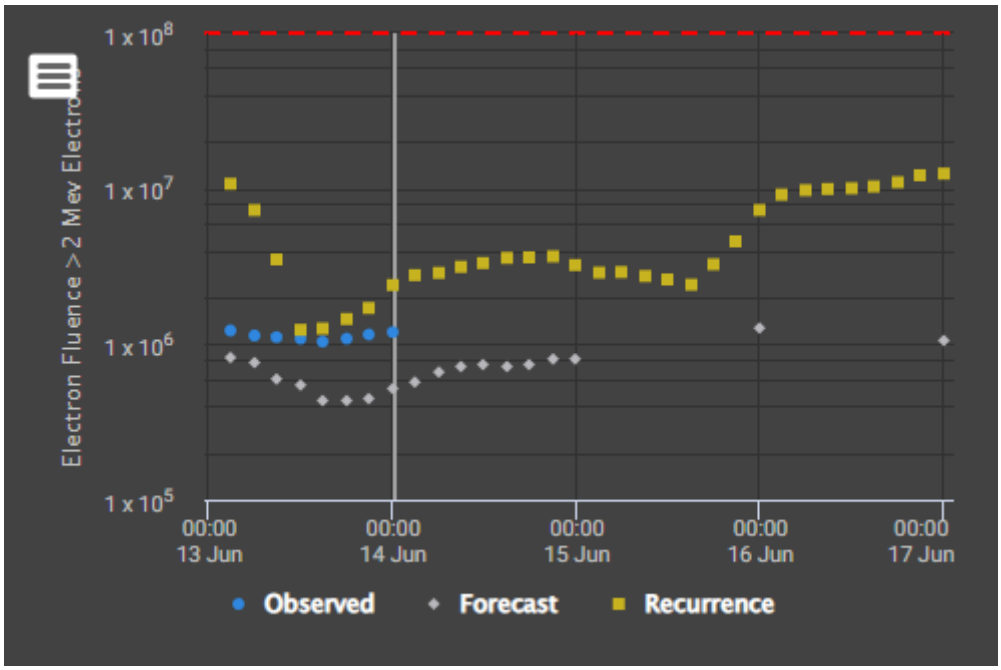
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux is expected to persist at generally background levels for much of this period with no or limited significant sources of enhancement expected. Some diurnal Moderate flux values becoming likely into the period however.

The associated 24 hour fluence is expected to remain well below the Active threshold (1e8 integrated pfu) and the MOSWOC REFM output is considered to provide reasonably good guidance, even if it seems to be slightly underestimating current levels.

GEO Electron Environment	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: MOSWOC REFM model.



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